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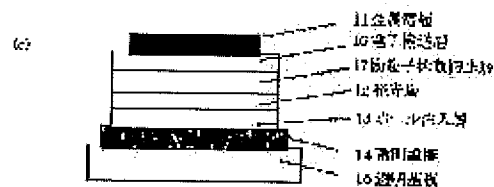
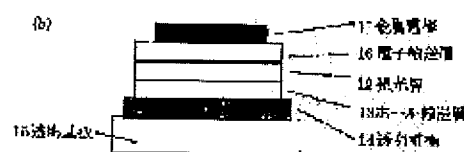
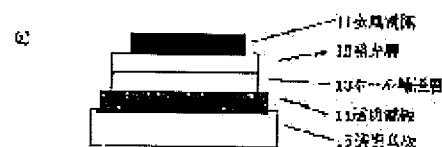
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## (54) POLYMER COMPOUND AND ORGANIC LIGHT EMITTING ELEMENT

(57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a compound having high light emission efficiency and high reliability, and to provide an organic light emitting element using the compound.

**SOLUTION:** The polymer compound having a structure in which a metal complex is bound to the side chain of the polymer, where the metal atom is bound at least with carbon atom or oxygen atom, is used as an organic light emitting layer. The element formed using the compound exhibits high efficiency and excellent stability with time along with good film formability.



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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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CLAIMS

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[Claim(s)]

[Claim 1] Are a metal complex portion a high molecular compound which it has, and this metal complex portion, A high molecular compound, wherein a metal atom combined with a composition atom which forms a polymer framework side chain, and this metal atom is the iridium Ir, and it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[Claim 2] Are a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom The platinum Pt, A high molecular compound, wherein it is either the rhodium Rh, ruthenium Ru, the osmium Os, the gold Au, palladium Pd, the copper Cu or the cobalt Co, and it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[Claim 3] The high molecular compound according to claim 1 or 2 characterized by emitting light in phosphorescence when said high molecular compound carries out energy transition from an excitation state to a ground state.

[Claim 4] The high molecular compound according to any one of claims 1 to 3, wherein said metal complex portion consists of two or more metal complexes of a mutually different structure.

[Claim 5] The high molecular compound according to any one of claims 1 to 4, wherein said high molecular compound is a copolymer.

[Claim 6] The high molecular compound according to any one of claims 1 to 5, wherein a molecular weight of said high molecular compound is 2,000 to 1,000,000.

[Claim 7] It is an organic light emitting element provided with a light-emitting part which contains a kind of organic compound in inter-electrode [ of a couple provided on a base ] at least, Said organic compound is a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom is the iridium Ir, An organic light emitting element being a high molecular compound, wherein it has furthermore joined together between at least one carbon atom or an oxygen atom and said polymer framework has conjugate structure.

[Claim 8] It is an organic light emitting element provided with a light-emitting part which contains a kind of organic compound in inter-electrode [ of a couple provided on a base ] at least, Said organic compound is a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom The platinum Pt, The rhodium Rh, ruthenium Ru, the osmium Os, the gold Au, palladium Pd, An organic light emitting element being either the copper Cu or the cobalt Co, and being a high molecular compound, wherein it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[Claim 9] An organic light emitting element given in either of claim 7 or 8, wherein an electrode of said couple which counters counters and said light-emitting part is located in this inter-electrode one.

[Claim 10] An organic light emitting element given in either of claim 7 or 9 characterized by

emitting light in phosphorescence when said light-emitting part carries out energy transition from an excitation state to a ground state.

[Claim 11]The organic light emitting element according to any one of claims 7 to 10, wherein a metal complex portion of said high molecular compound consists of two or more metal complexes which have a mutually different structure.

[Claim 12]The organic light emitting element according to any one of claims 7 to 11, wherein a molecular weight of said high molecular compound is 2,000 to 1,000,000.

[Claim 13]The organic light emitting element comprising according to claim 7 to 12:

Said light-emitting part is said layer of a kind of organic compound at least.

A layered product by which a layer containing a substance for conveying a career was laminated.

[Claim 14]The organic light emitting element comprising according to claim 7 to 12:

Said light-emitting part is said a kind of organic compound at least.

A mixture which consists of a substance for conveying a career.

[Claim 15]An image display device comprising:

Said organic light emitting element according to any one of claims 7 to 14.

A means to supply an electrical signal to said organic light emitting element.

[Claim 16]A process of preparing a high molecular compound which has conjugate structure, and a metal atom with the iridium Ir. A manufacturing method of a high molecular compound obtaining a high molecular compound with conjugate structure by process of preparing a metal complex compound united between at least one carbon atom or an oxygen atom, and a process to which these are made to react.

[Claim 17]A process of preparing a high molecular compound which has conjugate structure, and a metal atom The platinum Pt, The rhodium Rh, ruthenium Ru, the osmium Os, the gold Au, palladium Pd, A manufacturing method of a high molecular compound obtaining a high molecular compound with conjugate structure by process of being either the copper Cu or the cobalt Co, and preparing a metal complex compound united between at least one carbon atom or an oxygen atom, and a process to which these are made to react.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the organic light emitting element and compound which are used for a planar light source, a planate display, etc.

[0002] It is related with the light emitting device especially using a high molecular compound, and it is using in more detail a high molecular compound including a metallic bond as a luminescent material, luminous efficiency is high, and aging is related with few light emitting devices.

[0003]

[Background of the Invention] An organic light emitting element has the example (Thin Solid Films, 94 (1982) 171) etc. which made voltage impress and emit light on an anthracene vacuum evaporation film in ancient times. By however, an advantage, such as being able to drive compared with an inorganic light emitting device by that large-area-izing is easy, that desired coloring is obtained by development of various exotic materials, and the low voltage, and being in recent years. Furthermore, the application studies for device formation including material development are energetically performed as high speed response nature or an efficient light emitting device.

[0004] For example, generally an organic EL device has the composition in which the up-and-down two-layer electrode formed on the transparent substrate and the organic layer which contains a luminous layer in during this period were formed as explained by Macromol.Symp.125, and 1-48 (1997) in full detail.

[0005] As the aluminum quinolinol complex which has electron transport property and a luminescent characteristic, and an example of representation, Alq3 shown in the chemical formula 1 is used for a luminous layer. The material which has electron-donative [ , such as alpha-NPD shown in the chemical formula 1, for example as a triphenyl diamine derivative and an example of representation, ] is used for a hole transporting bed.

[0006] These elements show an electric rectifying action, when an electric field is impressed to inter-electrode, an electron is poured into a luminous layer from the negative pole, and a hole is poured in from the anode.

[0007] The hole and electron which were poured in are recombined within a luminous layer, produce an exciton, and when this changes to a ground state, they emit light.

[0008] In this process, there are an one-fold excitation paragraph state and a 3-fold paragraph state in an excitation state, the transition to a ground state from the former is called fluorescence, and the transition from the latter is called phosphorescence and calls the substance in these states 1-fold paragraph exciton and 3-fold paragraph exciton, respectively.

[0009] As for the organic EL device examined so far, fluorescence in case the many change from 1-fold paragraph exciton to a ground state is used. On the other hand, the examination using phosphorescence luminescence which went via the triplet exciton of the element is made these days.

[0010] The typical literature announced, Literature 1: Improved energy transfer in electrophosphorescent device (D. Applied Physics Letters Vol 74, No3 p422 besides F.O'Brien (1999))

Literature 2: Very high-efficiency. green organic light-emitting. It is devices basd on electrophosphorescence (M. Applied Physics Letters Vol 75, No1 p4 besides A.Baldo (1999)).

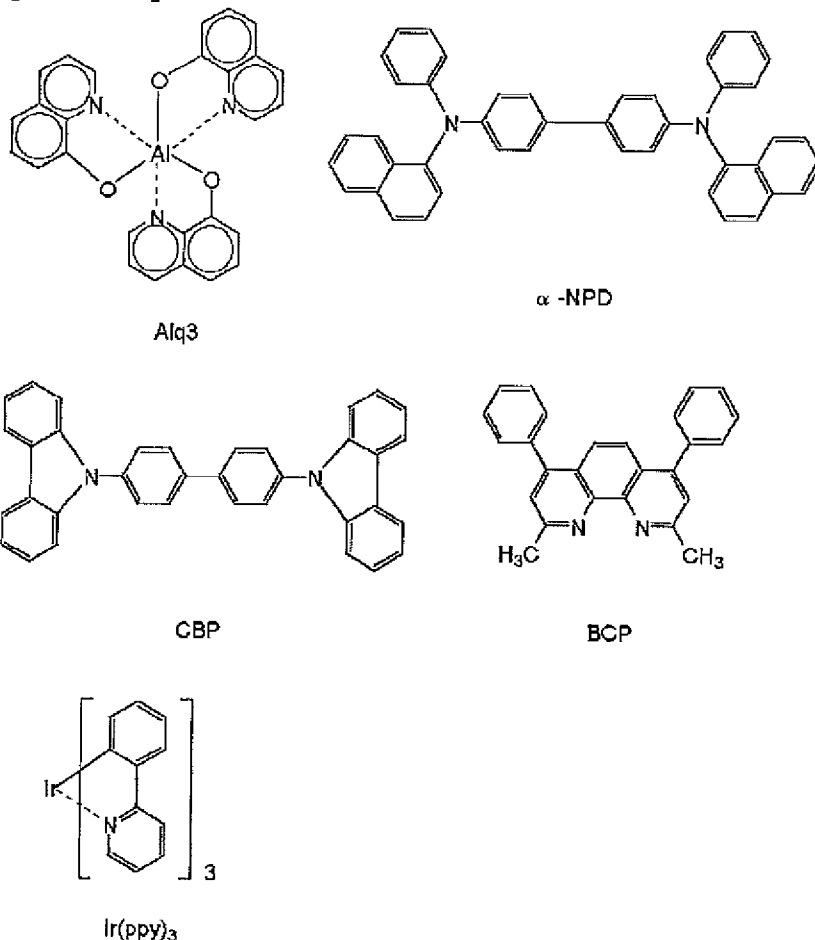
[0011] The composition which laminates four layers of organic layers pinched by inter-electrode in these articles is mainly used, and the used material is the carrier transport material and phosphorescence luminescence material which are shown in the chemical formula 1.

[0012] The abbreviation of each material is as follows.

[0013] Alq3: Aluminum quinolinol complex alpha-NPD : N4, N4'-Di-naphthalen-1-yl-N4, and N4 - ' -diphenyl-biphenyl-4 and 4' - diamine CBP: 4 and 4' - N, N' - dicarbazole-biphenyl BCP: 2 and

9-dimethyl-4,7-diphenyl-1,10-phenanthrolinePtOEP:platinum-octaethyl porphyrin-complex Ir (ppy)<sub>3</sub>: Iridium phenyl pyrimidine complex [0014]

[Formula 1]



[0015]the element from which the well head was acquired for the literature 1 and 2 -- Alq<sub>3</sub> and an exciton diffusion prevention layer being used with BCP, and CBP being made alpha-NPD and an electron transport layer with a host material at a luminous layer at a hole transporting bed, and, It was the element which uses for this what carried out distributed mixing of the PtOEP or Ir(ppy)<sub>3</sub> which is phosphorescence luminescence material by about 6% of concentration.

[0016]The reason especially the present phosphorescent luminescent material attracts attention is expectable [ high luminous efficiency ] for the following reasons theoretically.

[0017]The exciton generated by career recombination consists of a 1-fold paragraph exciton and a 3-fold paragraph exciton, and the probability is 1:3. Although the old organic EL device used firefly luminescence, theoretically, the luminescence yield was 25% to the generated number of excitons, and this was a maximum. However, if the phosphorescence generated from 3-fold paragraph exciton is used, one at least 3 times the yield of this will be expected theoretically and transition by the intersystem crossing from 1-fold paragraph to still higher 3-fold paragraph in energy will be taken into consideration, one 4 times the luminescence yield of 100% of this is theoretically expectable.

[0018]In the literature which required luminescence from a triplet, JP,11-329739,A (an organic EL device and a manufacturing method for the same), JP,11-256148,A (a luminescent material and the organic EL device using this), JP,8-319482,A (organic electroluminescent element), etc. are mentioned.

[0019]However, generally as for the organic light emitting element using the above-mentioned phosphorescence luminescence, the further improvement is called for about degradation and element stability of luminous efficiency like the firefly luminescence type element.

[0020]Although the details of this deterioration cause are unknown, this invention persons think

as follows based on the mechanism of phosphorescence luminescence.

[0021]When an organic luminous layer consists of a host material of carrier transport nature, and a guest of phosphorescence luminescence, the main processes in which it results in phosphorescence luminescence from 3-fold paragraph exciton consist of some following processes.

[0022]1. 3-fold paragraph exciton of 3-fold paragraph exciton generation 6. guest of energy transfer 5. guest from excitation energy transfer 4. host between exciton generation 3. host molecules of transportation 2. host of electron and hole within luminous layer to guest to ground state transition. The desired energy transfer and luminescence in the process of each phosphorescence luminescence are a competing reaction with various energy inactivation processes.

[0023]In order to raise the luminous efficiency of an organic light emitting element, it cannot be overemphasized that light quantity child yield of the luminescence center material itself is enlarged.

[0024]However, if there is too much concentration of a luminescence exciton, luminous efficiency will fall conversely as indicated by JP,05-078655,A and JP,05-320633,A. This is known as concentration quenching or concentration \*\*\*, and is considered that the unradiated transition which is not accompanied by luminescence by advance of an abundant embodying reaction with luminescence center materials or the circumference molecule of those as said competing reaction as this cause is related. Therefore, it is known regardless of a firefly luminescence substance or phosphorescence photogene, that the suitable concentration for the spatial density of a luminescence exciton exists in a luminous efficiency rise.

[0025]Especially in phosphorescence photogene, it is thought that the life of said 3-fold paragraph exciton generally originates in a triple or more figures long time from the life of 1-fold paragraph exciton. That is, since the time held at an energy-rich excitation state is long, the establishment to which an inactivation process happens increased by a reaction with a circumference substance, polymer formation by excitons, etc., change of a substance was caused by extension, and this invention persons think that it is easy to lead to life degradation.

[0026]

[Problem(s) to be Solved by the Invention]Then, the purpose of this invention is to provide an organic light emitting element with efficient and sufficient stability using phosphorescence photogene.

[0027]

[Means for Solving the Problem]In order to attain an aforementioned problem, in this invention, are a metal complex portion a high molecular compound which it has, and this metal complex portion, It came to provide a high molecular compound, wherein a metal atom combined with a composition atom which forms a polymer framework side chain, and this metal atom is the iridium Ir, and it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[0028]Simultaneously, are a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom The platinum Pt, The rhodium Rh, ruthenium Ru, the osmium Os, the gold Au, palladium Pd, It also came to provide a high molecular compound, wherein it is either the copper Cu or the cobalt Co, and it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[0029]It is an organic light emitting element provided with a light-emitting part which contains a kind of organic compound in inter-electrode [ of a couple furthermore provided on a base ] at least, Said organic compound is a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom is the iridium Ir, An organic light emitting element being a high molecular compound, wherein it has furthermore joined together between at least one carbon atom or an oxygen atom and said polymer framework has conjugate structure is

also provided.

[0030]It is an organic light emitting element provided with a light-emitting part which contains a kind of organic compound in inter-electrode [ of a couple provided on a base ] at least simultaneously, Said organic compound is a metal complex portion a high molecular compound which it has, and this metal complex portion, A metal atom combines with a composition atom which forms a polymer framework side chain, and this metal atom The platinum Pt, The rhodium Rh, ruthenium Ru, the osmium Os, the gold Au, palladium Pd, It came to provide an organic light emitting element being either the copper Cu or the cobalt Co, and being a high molecular compound, wherein it has joined together between at least one carbon atom or an oxygen atom further and said polymer framework has conjugate structure.

[0031]This invention persons controlled formation of concentration quenching and an excitation polymer by fixing phosphorescence luminescence center material by concentration suitably in polymers, and found out that efficient light was realizable.

[0032]

[Embodiment of the Invention]The fundamental element composition of this invention was shown in drawing 1 (a), (b), and (c).

[0033]As shown in drawing 1, generally the metal electrode 11 is formed so that an organic EL device may pinch the transparent electrode 14 which has 50–200-nm thickness on the transparent substrate 15, a two or more layers organic layer layer, and this.

[0034]By drawing 1 (a), the organic layer showed the example which consists of the luminous layer 12 and the hole transporting bed 13. Hole pouring is made easy to use ITO with a big work function, etc. as the transparent electrode 14, and to carry out from the transparent electrode 14 to the hole transporting bed 13. The alloy etc. which used aluminum, magnesium, or them make electron injection to the organic layer easy to carry out to the metal electrode 11 using the small metallic material of a work function.

[0035]Although the high molecular compound of this invention is used for the luminous layer 12, alpha-NPD etc. which are shown in the chemical formula 1, for example as a triphenyl diamine derivative and an example of representation can also use for the hole transporting bed 13 suitably the material which has electron-donative.

[0036]When an electric field is impressed so that the element which more than constituted shows an electric rectifying action, and it may become the negative pole about the metal electrode 11 and it may become the anode about the transparent electrode 14, an electron is poured into the luminous layer 12 from the metal electrode 11, and a hole is poured in from the transparent electrode 15.

[0037]It recombines within the luminous layer 12, an exciton arises, and the hole and electron which were poured in emit light. At this time, the role of an electronic blocking layer is played, the recombination efficiency in the interface between the luminous layer 12 and the hole transporting bed 13 increases, and luminous efficiency goes up the hole transporting bed 13.

[0038]Furthermore by drawing 1 (b), the electron transport layer 16 is formed between the metal electrode 11 of drawing 1 (a), and the luminous layer 12. Luminous efficiency is raised by separating a luminescence function, an electron, and a hole transportation function, and having more effective career blocking composition. As the electron transport layer 16, an oxadiazole derivative etc. can be used, for example.

[0039]As shown in drawing 1 (c), it is also a desirable gestalt to consider it as 4 lamination which consists of the hole transporting bed 13, the luminous layer 12, the exciton diffusion prevention layer 17, the electron transport layer 16, and the metal electrode 11 from the transparent electrode 14 side which is the anode.

[0040]The high molecular compound used for this invention points out a with a molecular weights of 2000 or more compound, Have in intramolecular the metal complex coupled directly with the atom which constitutes a polymers main chain, carry out phosphorescence luminescence to it further, and the minimum excitation state, It is thought that the MLCT\* (Metal-to-Ligand charge transfer) excitation state and pi-pi \* excitation state of a 3-fold paragraph state exist.

[0041]The value with as high phosphorescence yield of the high molecular compound used for

[0042] If this phosphorescence life is not much long, in order that energy saturation may occur, luminous efficiency falls remarkably and is not used for a light emitting device. If the molecule of 3-fold paragraph excitation state of a luminescence waiting state increases, as mentioned above, it will become a factor which reduces luminous efficiency with various competing reactions. When the current sent especially through an element became high-density, there was a problem said that luminous efficiency falls.

[0044] Since it had various luminous wavelengths also by the structure of a metal complex part, by including the ligand from which structure differed in a polymers main chain, this material provided material with a large luminous wavelength, and enabled production of the element.

[0046]

(各々の水素原子は他の原子置き換わってもよい)

[0047] It is also possible to use the high molecular compound using a metal complex which changes into the metal complex used by this invention, and is different, or it is also possible to mix and use two or more compounds.

[0048] It is also possible for more than one to be mixed with the high molecular compound usually using the high molecular compound of this invention as the moving bed etc., and the element which has a large luminous wavelength by this is produced, or creation of the higher element of



luminous efficiency is enabled more.

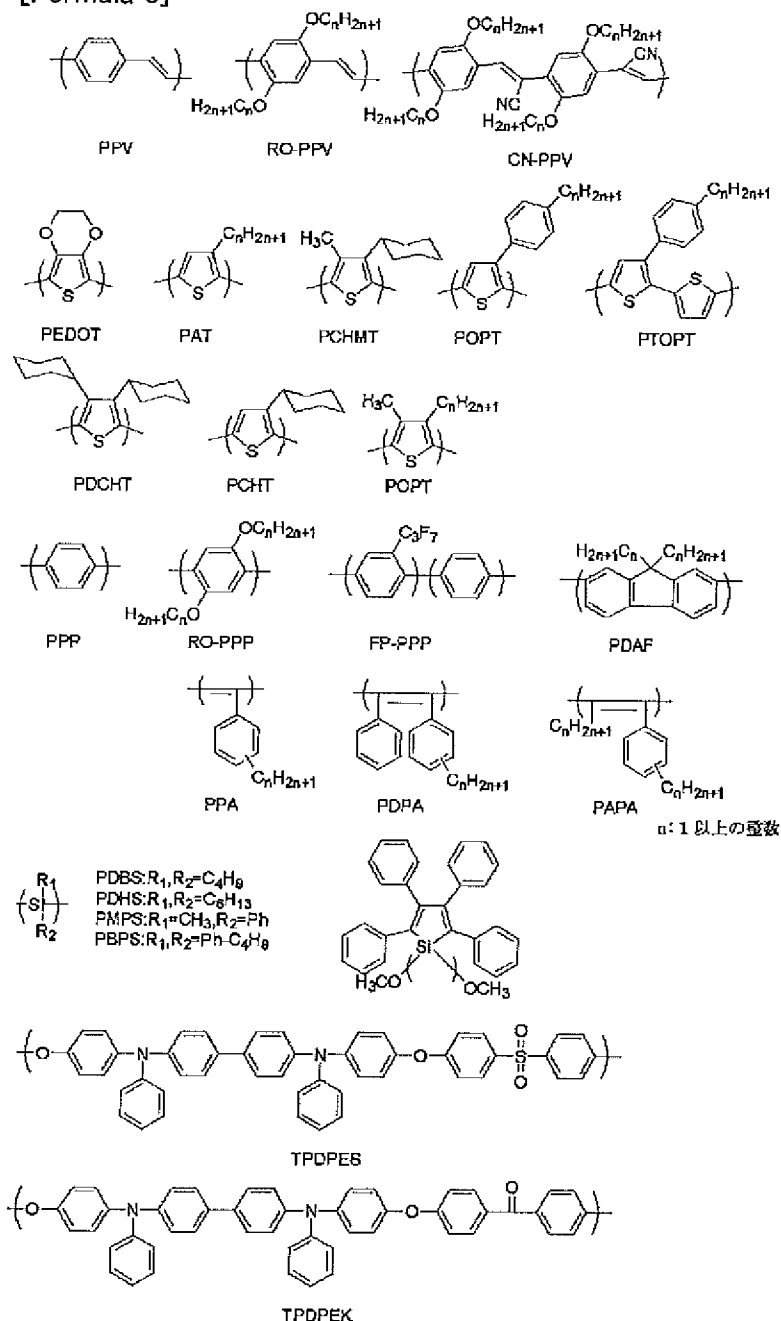
[0049] Preventing the crystal deposit at the time of element creation furthermore etc. can contribute membrane formation nature also to improving.

[0050] Preventing the crystal deposit at the time of element creation furthermore etc. can contribute membrane formation nature also to improving.

[0051] PPV as shown in the following chemical formula 3 as an example of the polymer material in which said mixing is possible (poly para-phenylene vinylene), And RO-PPV, CN-PPV, DMOS-PPV which are the derivative, . They are MEH-PPV, PAT (polythiophene), and its derivative. . They are PEDOT, PCHMT, POPT, PTOPT, PDCHT, PCHT, PPP, and its derivative. RO-PPP, FP-PPP, PDAF (poly dialkyl fluorene), PPA, PDPA, PAPA which are PVK (polyvinyl carbazole) and a polyacetylene derivative, There are TPDPEs, TPDPEK, etc. which are polymer of PDBS, PDHS, PMPS and PBPS which are sigma conjugation system polymer of a polysilane system, a polysilane system, and a triphenylamine system.

[0052]

[Formula 3]

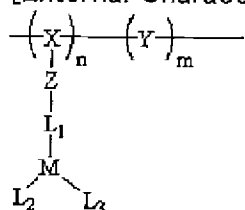


[0053] The example of the general formula of the high molecular compound used by this invention

is shown below. However, this invention is not limited to these. The polymers of this invention may perform other polymer precursors and copolymerization. The main chain of the polymers of this invention shows the  $-(X)_n-(Y)_m$ -portion of a following general formula, and a side chain shows  $-Z-L_1-M-L_2$  (L3).

[0054]

[External Character 1]

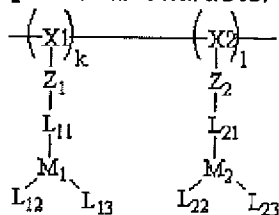


[0055]The basis on which X have conductivity, such as vinylene, phenylene, phenylenevinylene, and a thiophene, is mentioned among a formula. The polymers of Y which have conductivity, such as phenylenevinylene, a thiophene, and a fluorene, are desirable. A single bond may be sufficient. Although Z does not have restriction in particular, aromatic groups, those combination, etc., such as alkyl groups, such as methylene and ethylene, and phenylene, are mentioned. A single bond may be sufficient. The platinum Pt, rhodium Rh, ruthenium Ru, iridium Ir, osmium Os, gold Au, palladium Pd, copper Cu, or cobalt Co of M is good, and platinum, rhodium, a ruthenium, and iridium are especially preferred. L1 shows the basis which has a carbon-metallic bond or an oxygen-metallic bond at least, and the derivative and beta-diketones which have the derivative and pyridine skeleton which have the derivative and phenyl group skeleton which have a ligand mentioned to the above-mentioned chemical formula 2, picolinic acid, and these skeletons are mentioned. L2 and L3 have desirable bidentate \*\*\*\*\* which have the derivative and pyridine skeleton which have the derivative and phenyl group skeleton which have a ligand mentioned to the above-mentioned chemical formula 2, picolinic acid, and these skeletons, such as a derivative and beta-diketones, although there is no restriction in particular. When metal is 4 coordination, there may not be L3. L2 and L3 may be the same, or they may differ. m and n show a degree of polymerization and are suitably determined by the viewpoints of luminous efficiency, conductivity, etc. However, n is not 0.

[0056]Two or more metal and ligands may be contained by intramolecular of a high molecular compound like a following general formula. A main chain of this invention in a following general formula shows a  $-(X1)_k-(X2)_l$ -portion, and a side chain shows  $-Z1-L11-M1-L12$  (L13) and  $-Z2-L21-M2-L22$  (L23).

[0057]

[External Character 2]



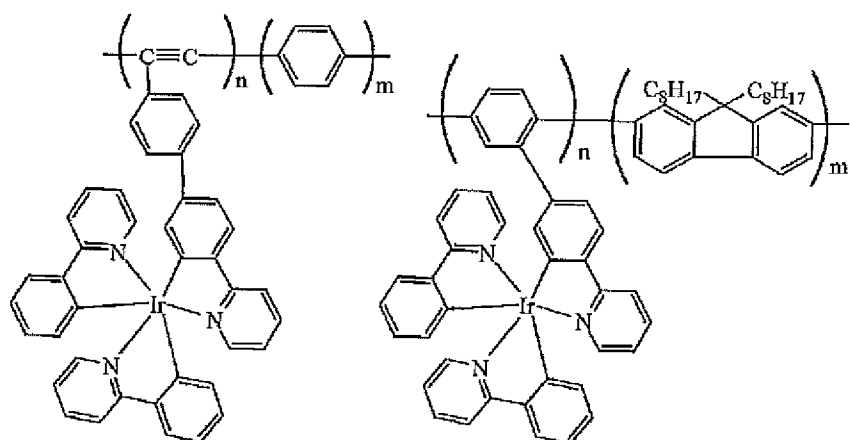
[0058]X of the above [ X1 and X2 ] respectively -- Z of the above [ Z1 and Z2 ] -- k and l apply to L11 and L1 of the above [ L12 ] L22 and L2 of the above [ L23 ], and apply to M of the above [ M1 and M2 ] at the aforementioned m and n L13 and L3 of the above [ L23 ].

[0059]The example of the high molecular compound used by this invention is shown below.

[0060]Here, the high molecular compound which combined with the polymers side chain the iridium complex, the rhodium complexes, and the platinum complex which made phenylpyridine etc. the ligand as a metal complex is illustrated.

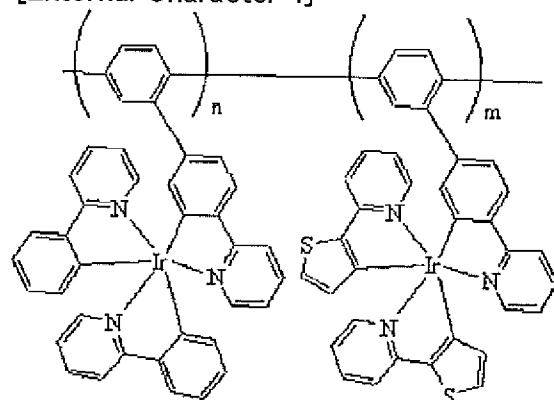
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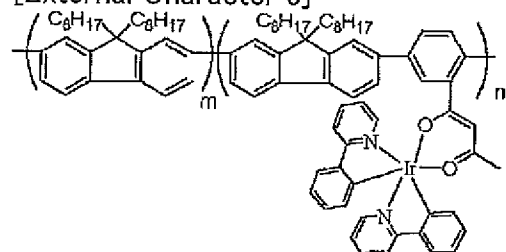
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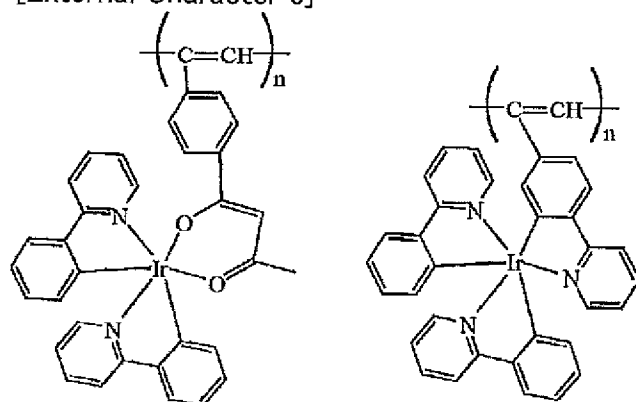
[0063]

[External Character 5]



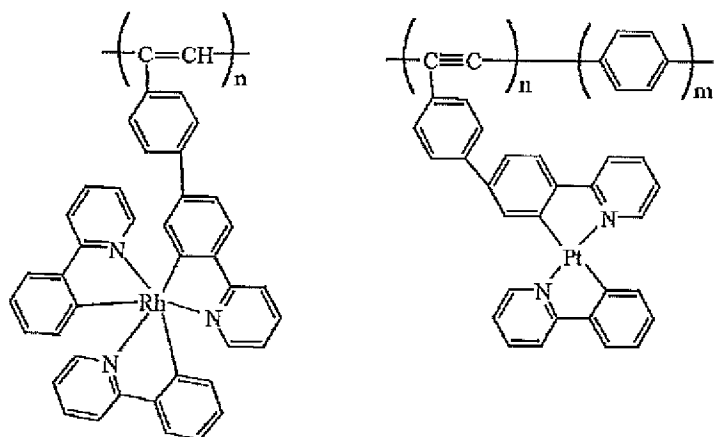
[0064]

[External Character 6]



[0065]

[External Character 7]



[0066]However, since combination of versatility [ coupling method / of the above-mentioned monomer or a metal complex ] is expected as a feature of a polymeric reaction, it cannot be overemphasized that the structure of a resultant is not limited to the above-mentioned statement. It is possible to change with conditions about a degree of polymerization similarly, and to also make it change from that whose molecular weight is about thousands to about millions.

[0067]However, it is necessary on organic light emitting element creation to form these luminous layers on a substrate. At this time, it is not desirable by wettability worsening at the time of with \*\*, if a molecular weight is not much small, and film peeling taking place easily in the back with \*\* etc. On the other hand, if 1 million is exceeded, it becomes difficult to melt into a solvent used at a process with \*\*, and may deposit, and the viscosity of a solution may be large and performance with \*\* may worsen.

[0068]Then, generally it is easy to use 2,000 to about 1,000,000 as a desirable molecular weight.

[0069>About 3000 to 100,000 range is suitable for a still more desirable range.

[0070]An example is given to below and this invention is concretely explained to it.

[0071]In this example, although an iridium (Ir) complex was mainly used as a metal complex, it is not limited to these.

[0072](Example 1) By the reaction of the following statement, the compound 9 which has an iridium complex in a polymers side chain was obtained.

[0073]\*\* A synthetic iridium chloride and phenylpyridine of the compounds 2 and 3 were used as a raw material, Sergey Lamansky et al. Inorg. Chem. 40 p1704 (2001) was referred to, and the compounds 2 and 3 which are the intermediates of an iridium complex were compounded.

\*\* After carrying out the time nitrogen purge of the drying glycerol 50 ml to a synthetic 100 ml eggplant flask of the compound 5 130 degrees2, the compound 3 (1.2 g, 2 m mol) and the compound 4 (1.2 g, 2.5 m mol) were thrown in, and heating stirring was carried out under a nitrogen air current for 18 hours. A reactant was cooled to a room temperature, and it poured into 600 ml of 1-N chloride, and rinsed after separating a sediment. Then, it refined using preparative isolation HPLC and 300 mg obtained powder which is 6 coordination iridium compound 5.

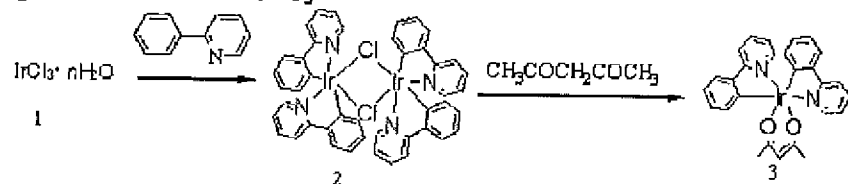
\*\* The synthetic compound 5 (300 mg, 0.22 m mol) of the compound 7, Put the compound 6 (42 mg, 0.22 m mol) into 20 ml eggplant flask by which the nitrogen purge was carried out, and 2 ml of toluene, 1 ml of ethanol, solution of 2 M-K<sub>2</sub>CO<sub>3</sub> It mixed to 2 ml, after fully agitating under nitrogen, 40 mg (0.035m mol) added Pd(PPh)<sub>4</sub>, and flowing back was performed for 8 hours. It extracted to add toluene and water to reaction post mixing liquid, and an organic layer was dried with magnesium sulfate. Alumina chromatography refines after that and it is the powder of the compound 7. 150 mg was obtained.

The compound 7 refined in 10 synthetic minutes of the high molecular compound 9 \*\* 150 mg (0.2 m mol), The polymers monomer 8 is put into 20 ml eggplant flask by which the nitrogen purge was carried out in 129 mg (0.2 m mol), It mixed to tetrahydrofuran (it abbreviates to THF) 1 ml, and 2 M-K<sub>2</sub>CO<sub>3</sub> solution 0.6 ml, after fully agitating under nitrogen, 1.73 mg (0.00015mmol)

added  $\text{Pd(PPh)}_4$ , and flowing back was performed for 48 hours. With methanol, it reprecipitated and backwashing by water of the reaction post mixing liquid was carried out. Soxhlet washing was 24 h Performed using acetone after that, and powder 195 mg of the high molecular compound 9 of this invention was obtained.

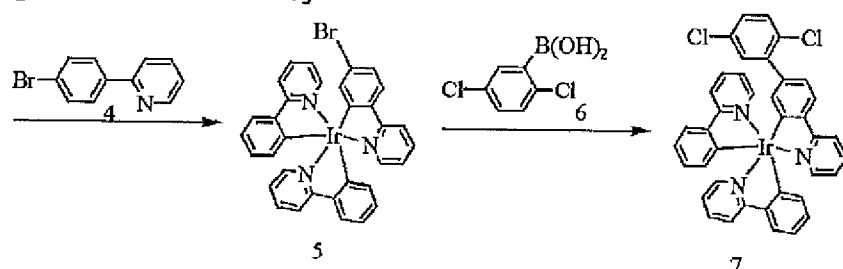
[0074]

[External Character 8]



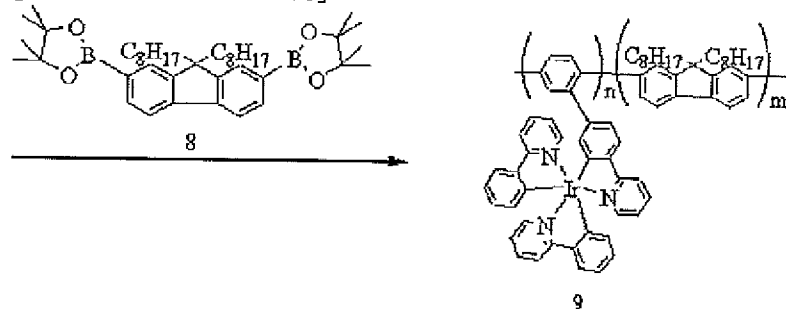
[0075]

[External Character 9]



[0076]

[External Character 10]



[0077] Luminescence compared photoluminescence with the solution in which discernment of fluorescence or phosphorescence carried out the nitrogen purge of said high molecular compound 9 to the solution which dissolved in chloroform and carried out oxygen substitution. As for the solution, as for, the solution which carried out oxygen substitution of the result carried out the nitrogen purge to luminescence originating in an iridium complex hardly having been seen, photoluminescence was checked. From these results, it checked that the high molecular compound of this invention was phosphorescence luminescence.

[0078] About this high molecular compound, a luminescence life was investigated by the following methods.

[0079] A high molecular compound was first melted in chloroform, and the spin coat was carried out by a thickness of about 0.1 micrometer on a quartz substrate. Pulse irradiation of the nitrogen laser light with an excited wavelengths of 337 nm was carried out for this at a room temperature using the Hamamatsu Photonics luminescence life measuring device. Damping time of luminescence intensity after excitation pulses finish was measured.

[0080] When  $I_0$  of the early luminescence intensity is carried out, the luminescence intensity  $I$  of  $t$ -hour after is defined by the following formulas using the luminescence life  $\tau$ .

[0081]  $I = I_0 \exp(-t/\tau)$

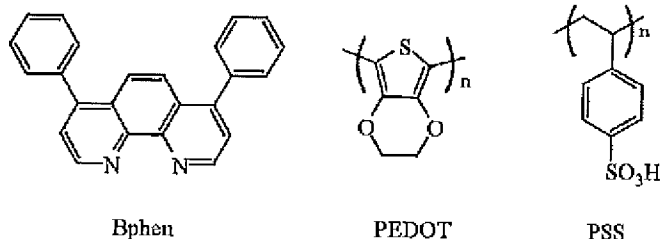
This high molecular compound 9 showed phosphorescence luminescence, and the phosphorescence life was a short life in less than 10microsec and phosphor.

[0082](Example 2) Using the high molecular compound 9 obtained in above-mentioned Example 1, an organic layer shown in drawing 1 (b) created an organic light emitting element of three layers, and measured an element characteristic. 100-nm indium oxide (ITO) was formed and patterned in a sputtering technique as the transparent electrode 14 on this, using an alkali-free-glass board as the transparent substrate 15.

[0083]40 nm of thickness formed a poly membrane which consists of PEDOT besides expressed with the following structural formula as the hole transporting bed 13, and PSS with a spin coat method. The spin coat of the 0.5% chloroform fluid of the high molecular compound 9 of Example 1 was carried out on it many times, it dried in 60 °C oven for 60 minutes, and the luminous layer 12 of 30 nm of thickness was obtained. Furthermore, resistance heating vacuum evaporation was performed for a compound expressed with the following Bphen with a degree of vacuum of  $10^{-4}$  Pa as the electron transport layer 16, and an organic layer of 40 nm of thickness was obtained.

[0084]

[External Character 11]



[0085]Besides, 5 nm of potassium fluorides KF have been arranged as an under-coating layer of the metal electrode layer 11.

[0086]Furthermore, as the metal electrode 11, the aluminum Al film of 100-nm thickness was vapor-deposited, and the transparent electrode 14 and the electrode area which counters patterned in the shape which becomes 3-mm<sup>2</sup>.

[0087]The characteristic of the organic light emitting element measured the current potential characteristic with the microammeter 4140B by a HYU red puckered company, and measured light emitting luminance by BM7 by TOPCON CORP. The element using the compound of this example showed the good rectifying action.

[0088]Luminescence from an organic light emitting element was checked by up-and-down inter-electrode one at the time of voltage 15V impression.

[0089]Since this luminescence was similar with photoluminescence luminescence which dissolved into a toluene solution and measured a luminescent material used for this example, it was checked that it is luminescence from a luminescent material which is an iridium complex.

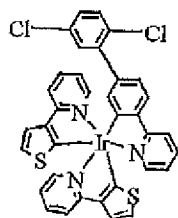
[0090]When the luminescent characteristic of this organic light emitting element was measured, a phosphorescence life of this element was 2 or less microseconds to generally several n luminescence lives of a fluorescent material being sec - tens n sec.

[0091](Example 3) the same synthesizing method as Example 1 -- composition of the compound 10 -- another this application high molecular compound 11 was compounded by the following methods.

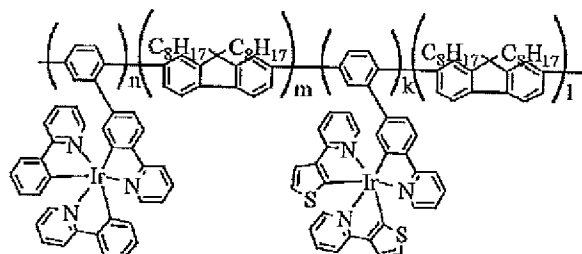
[0092]They are 75 mg (0.1 m mol) and a compound about the fully refined compound 7. 10 is put into 20 ml eggplant flask by which the nitrogen purge was carried out in 129 mg (0.2 m mol) for 81 mg (0.1m mol) and three sorts of compounds of the compound 8, Furthermore, they are THF 1 ml and 2 M-K<sub>2</sub>CO<sub>3</sub> solution. After mixing to 0.6 ml and fully agitating in nitrogen, Pd(PPh)<sub>4</sub> 1.73 mg (0.00015 m mol) was added, and flowing back was performed for 48 hours. Mixed liquor was made to reprecipitate to methanol after a reaction, and backwashing by water was carried out further. Soxhlet washing was performed for 24 hours using acetone after that, and powder 120 mg of the high molecular compound 11 which is another invention of this application was obtained.

[0093]

[External Character 12]



10



11

[0094] Since this luminescence was also similar with photoluminescence luminescence which dissolved into the toluene solution and measured the luminescent material, it was checked as it is luminescence from this luminescent material. At the room temperature, the characteristic of an organic light emitting element is the microammeter 4140B by a HYU red pucker company about the current potential characteristic, and measured light emitting luminance BM7 by TOPCON CORP. The element using the compound of this example showed the good rectifying action.

[0095] At the time of voltage 15V impression, luminescence from this organic light emitting element was checked in the practical use category temperature range. In this example 3, the green emission of the broadcloth peak originating in two kinds of Ir complexes considered to originate in the compound 4 and the compound 6 was checked.

[0096] Also about this luminescence, said method showed that it was phosphorescence.

[0097] (Example 4) It evaluated by creating an organic light emitting element like Example 2 by making into a luminous layer the high molecular compound 11 compounded in Example 3, and the mixture which mixed the polyvinyl carbazole PVK by 1:1.

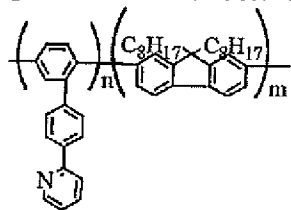
[0098] This light emitting device checked luminescence from this light emitting device at the time of voltage 13V impression while showing a good rectifying action. Since that light was similar with photoluminescence luminescence which dissolved into a toluene solution and measured a luminescent material used for this example, it checked that it was luminescence from this iridium complex.

[0099] (Example 5) A driving waveform shown in drawing 2 as Example 5 using a light emitting device of Example 2 and Example 4 in a room temperature was energized, and time to halve light emitting luminance was found.

[0100] (Comparative example) As a comparative example, a thing mixed in the following high molecular compound 12 compounded by the same method as Example 1 was used as a conventional luminescent material as the luminous layer 12, using Ir(ppy)<sub>3</sub> written in this specification. An organic light emitting element was created like Example 2 below.

[0101]

[External Character 13]



12

[0102] The result of the energization torture test in the room temperature of the element using each compound is the following.

[0103] Luminosity half line becomes large more clearly than an element using the conventional luminescent material, and an element with high endurance originating in the stability of material of this invention becomes possible.

[0104]

[Table 1]

	発光層材料	輝度半減時間 (hr)
実施例 2 の素子	9	600
実施例 4 の素子	1 1 + P V K 混合	650
比較例素子	Ir(ppy) <sub>3</sub> + 1 2	950

[0105](Example 6) Two examples of a display are explained below. An example which created an image display device which has XY matrix wiring first is shown in drawing 2.

[0106]a 1.1-mm-thick 150-long mm, 150-wide mm, and glass substrate top -- an ITO film of about 100-nm thickness was patterned as a transparent electrode (anode side), and 100 lines was patterned at intervals of LINE/SPACE=100micrometer/40 micrometers as a passive-matrix electrode after formation in a sputtering technique. An organic compound layer which consists of three layers on the conditions as Example 3 that it is next the same was created.

[0107]Then, membranes were formed with a vacuum deposition method on condition of degree-of-vacuum  $2 \times 10^{-5}$  Torr so that a metal electrode for 100 lines might be intersected perpendicularly with a transparent electrode by LINE/SPACE=100micrometer/40 micrometers in mask deposition. As for a metal electrode, 5 nm of thickness formed AL by 150-nm thickness continuously in KF.

[0108]Simple matrix driving was performed on the voltage of 7 to 13 volts using the 10 volts scanning signal and the \*3-volt information signal which are shown in drawing 3 in the glove box which filled this passive-matrix type organic EL device of 50x50 with a nitrogen atmosphere. When the INTARESU drive was carried out with the frame frequency of 30 Hz, monochrome binary format image has been checked.

[0109]The lightweight flat-panel display provided with energy saving or high visibility of the efficient light emitting device shown by this invention becomes possible as an image display device. It is available as a line shutter which forms the light emitting device of this invention in line form, approaches a photoconductive drum, places as a light source for printers, drives each element independently, and exposes a request to a photoconductive drum. On the other hand, the use to the back light of a lighting system or a liquid crystal display can expect an energy saving effect.

[0110]Especially the active-matrix image display element that changed into XY matrix wiring described previously in another application to an image display element, and was provided with the thin film transistor (TFT) is useful. With reference to drawing 4 - 6, the active-matrix image display element of this invention is explained below.

[0111]Drawing 4 is a mimetic diagram of the top view of the above-mentioned panel. It is connected to the direction wiring of Y called the drive circuit which consists of a scanning signal driver or a current supply source, and the direction scanning line of X which the status signal input means (these are called a picture information feeding means) which is an information signal driver is arranged, and is called a gate line, respectively and an information line around a panel, and a current supply source line. A scanning signal driver chooses a gate scanning line one by one, and a picture signal is impressed from an information signal driver synchronizing with this. The pixel for a display is arranged on the intersection of a gate scanning line and an information line.

[0112]Next, operation of a pixel circuit is explained using an equivalent circuit. If a selection signal is impressed to a gate selection line now, TFT1 will be set to ON, a status signal will be supplied to the capacitor Cadd from an information signal line, and the gate potential of TFT2 will be determined. According to the gate potential of TFT2, current is supplied to the organic light emitting element part (it abbreviates to EL) arranged at each pixel from a current supply source line. Since the gate potential of TFT2 is held throughout [ one frame term / Cadd ], the current from this period average current supply line continues flowing through it into an EL element part. This becomes possible throughout [ one frame term ] to maintain luminescence.

[0113]Drawing 6 is a figure showing the mimetic diagram of the section structure of TFT used by this example. A polysilicon p-Si layer is provided on a glass substrate, and an impurity



respectively required for a channel, a drain, and the source region is doped. Besides, a gate electrode is provided via gate dielectric film, and the drain electrode and source electrode linked to the above-mentioned drain area and the source region are formed. At this time, a drain electrode and a transparent picture element electrode (ITO) are connected by the contact hole opened in the intervening insulator layer.

[0114] There is no limitation in particular in the active element used by this invention, and the single crystal silicon TFT and amorphous silicon a-SiTFT can also be used.

[0115] On the above-mentioned picture element electrode, the organic luminous layer of a multilayer or a monolayer can be formed, the metal electrode which is the negative pole can be laminated one by one, and an active type organicity light-emitting display device can be obtained.

[0116]

[Effect of the Invention] According to this invention, the new high molecular compound which has phosphorescence luminescence can be obtained. By using the high molecular compound as a luminous layer, concentration \*\*\*\* cannot get up easily and an organic light emitting element with high luminous efficiency can be obtained. It is effective also in lengthening the life time of an element. In combination with the active element further especially using a thin film transistor, it has good intermediate color and a stable display is attained also at a prolonged display.